Activity Title: Meteorologists: Ocean and Atmospheric Interactions

Subject: Tracking weather

Grade Level: 4-8

Average Learning Time:

- Teaching the lesson (introduction of the OceanQuest activity) — one class period
- Student research and completion — 4-5 class periods (includes research and project)

Lesson Summary (Overview/Purpose):

Using the webquest *OceanQuest* created by Teacher at Sea Alumni Megan O'Leary and Stacey Klimkosky, students will research the definition and history of meteorlogy, including different technologies used and the importance of the data collected.
OceanQuest: http://truromass.org/oceanquestmeteorologists.htm

Overall Concept (Big Idea/Essential Question):

Weather conditions, including life and ship-threatening storms, are an integral part of sea voyages. The meteorologists on our journey will be responsible for tracking weather conditions to ensure a safe passage for all members of our team. The meteorological team will also be responsible for tracking the El Nino and La Nina events in the equatorial Pacific. These two phenomena have an impact on the weather in many different places such as Australia and the United States.

Specific Concepts (Key Concepts):

Upon completion of the lesson, students will understand the definition of meteorology. They will understand that the interaction between the oceans and our atmosphere has a dynamic effect on the weather across our globe. The students will also understand the different instruments used to track the weather and how data is collected and used by scientists all over the world.

Focus Questions (Specific Questions):

1. What is meteorology
2. How does NOAA use meteorological data
3. Why is data collected in the equatorial pacific?
4. How is the data used?

5. What are El Nino and La Nina?
6. Why is meteorology an important science to study?
7. What are weather models and how do meteorologists use them?

Objectives/Learning Goals:

Students will be able to demonstrate good to excellent knowledge (scores of 3-4) on the 7 Focus Questions stated above as defined by the OceanQuest Rubric. Students will:

1. Define meteorology as the study of the atmosphere
2. Identify the instruments used by meteorologists to collect atmospheric data, including anemometers, radiometers, rain gauges, temperature and humidity sensors and weather balloons.
3. Identify the areas in the equatorial Pacific where El Nino and La Nina are being tracked
4. Communicate that the data collected from the meteorological sensors and weather balloons are used daily be meteorologists around the world.
5. Articulate why meteorology is such an important science.

Background Information:

Teachers should view/listen to all listed links in the "Meteorologist" section of *OceanQuest* (http://truromass.org/oceanquestmeteorologists.htm).
Lesson, along with the other NOAA careers listed on the

Common Misconceptions/Preconceptions:
n/a

Materials:

- Computer or tablet with Internet connection
- *OceanQuest* website, Hydrographers page: http://truromass.org/oceanquestmeteorologists.htm

- PowerPoint or other presentation software

Technical Requirements:

- Computer or tablet with Internet connection
- *OceanQuest* website, Meteorologists page: http://truromass.org/oceanquestmeteorologists.htm
- PowerPoint or other presentation software

Teacher Preparation:

Teachers should view/listen to all listed links in the Hydrographers section of *OceanQuest* (http://truromass.org/oceanquestmeteorologists.htm).
Lesson, along with the other NOAA careers listed on the "Process" page: http://truromass.org/oceanquestprocess2.htm.

Keywords:

Meteorology
La Nina
El Nino
Drought
Dry bulb temperature
Wet bulb temperature
Sea surface temperature
Humidity
Barometric pressure
Upwelling
Stratus Buoy

Pre-assessment Strategy/Anticipatory Set:
n/a

Lesson Procedure:

1. If the lesson is being taught as a "stand alone" lesson, provide some background on the *OceanQuest* webquest, highlighting the "TASK" link (http://truromass.org/oceanquesttask.htm) and focusing on the Hydrographers information.

2. Direct students to the "Meteorologists" section of the OceanQuest webquest: http://truromass.org/oceanquestmeteorologists.http, or by clicking on PROCESS link and then METEOROLOGISTS. Before allowing students to work on their own, if necessary, preview each link and discuss how to utilize it to find information.

3. Background information: In its simplest definition, El Nino is a warming of the ocean waters of the equatorial Pacific. The opposite of which is La Nina, or a cooling of the ocean waters of the same region. The term El Nino, which means Christ Child, was first used in the 1800's by the fishermen of Peru to explain the difference in water temperature around Christmas time. Sir Gilbert Walker was a meteorologist, and in 1924 he was able to make the connections between the ocean and atmosphere that is today know as El Nino. In the 1960's, Jacob Bjerknes also noted the El Nino Southern Oscillation also

known as ENSO. These two men were working without computer models, Stratus Buoys or the RONALD H BROWN to assist in conducting their research. When the waters of the equatorial Pacific are warmer than normal, it impacts the wind, the weather and ocean currents. So, now that you have a little bit of background, what impact does El Nino have on our lives? It actually has a global impact. El Nino can cause drought in India, forest fires in Indonesia, bleaching of the Great Barrier Reef in Australia, a drop in the number of fish off the coast of Peru, tropical fish are likely to come further north in the Pacific Ocean, a milder winter over the northern United States and a wetter winter from Texas to Florida. It is truly remarkable that a temperature difference in the equatorial Pacific could have such long reaching effects all over the globe! Because of these global implications, it is essential that scientists across the globe continue to cooperate and share thoughts and ideas so that we can figure out the VERY complex systems of the oceans and atmosphere!

3. This lesson is best completed by working with partners or small groups.

Assessment and Evaluation:

Students will complete a 3-5 slide PowerPoint (or other presentation software) presentation addressing the Objectives and Learning Goals. Presentations will be delivered to the class and evaluated based on the rubric provided in the EVALUATION link of the OceanQuest webquest. (http://truromass.org/oceanquestevaluation.htm). If desired, teachers may use any other means of assessment including written reports, posters, student-created plays, etc.

Author: Megan O'Leary
Teacher at Sea 2007 aboard NOAA Ship *Ronald H. Brown*
Mission: Stratus 7 recovery and Stratus 8 deployment

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Standards:

National Science Education Standards Addressed:
Science as Inquiry Standards:
Abilities necessary to do scientific inquiry; Understanding about scientific inquiry
Physical Science Standards:
Properties of object and materials; Motions and forces
Science and Technology Standards:
Abilities of technological design; Understanding about science and technology

Ocean Literacy Principles Addressed:

Principle #1: The Earth has one big ocean with many features.

. c. Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of the Earth's rotation (Coriolis effect), the Sun, and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation.

. f. The ocean is an integral part of the water cycle and is connected to all of the earth's water reservoirs via evaporation and precipitation processes.

Principle #3: The ocean is a major influence on weather and climate.

. a. The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems.

. c. The El Niño Southern Oscillation causes important changes in global weather patterns because it changes the way heat is released to the atmosphere in the Pacific.

. f. The ocean has had, and will continue to have, a significant influence on climate change by absorbing, storing, and moving heat, carbon and water.

. g. Changes in the ocean's circulation have produced large, abrupt changes in climate during the last 50,000 years.

Principle #6: The ocean and humans are inextricably interconnected.

. a. The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.

Principle #7: The ocean is largely unexplored.

. b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.

. d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

. e. Use of mathematical models is now an essential part of ocean sciences. Models help us understand the complexity of the ocean and of its interaction with Earth's climate. They process observations and help describe the interactions among systems.

. f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

Massachusetts State Science& Technology Standards Addressed: Earth & Space Science Gr. 6-8

Heat Transfer in the Earth: 4. Explain the relationship among the energy provided by the sun, the global patterns
of atmospheric movement, and the temperature

	differences among water, land, and atmosphere. Earth's History: 6. Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.
Earth and Space Science Gr. 3-5 wind	Weather: 6. Explain how air temperature, moisture, speed and direction, and precipitation make up the weather in a particular place and time. 8. Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation. 11. Give examples of how the cycling of water, both in and out of the atmosphere, has an effect on climate.